Flavor Challenges in Non-dairy Frozen Dessert

Monica Kapoor

Oct 23-24, 2023

EDLONG | Everything Dairy Can Be.

Speaker Bio

- Monica Kapoor is a Principal Scientist at Edlong Corporation in their Applications Team. In this role, she solves customer challenges in flavor by working side-by-side with customer R&D and Edlong flavorists to deliver flavor solutions.
- Monica has over 20 years of experience in the food industry working for leading food ingredient and flavor companies where she continues to lead food ingredient focused R&D in a variety of food ingredients and products such as dairy, fats and oils, beverages, seasonings, and plant-based systems.
- Monica received her M.S. in Food Science from Kansas State University and her B.S. in Biology from Beloit College.

Agenda

1. Who is Edlong?

2. Where do flavor challenges in non-dairy frozen desserts come from?

3. Strategies to mitigate flavor challenges in non-dairy frozen desserts.

EDLONG THEN

1914

1960s

1980s

1990s

EDLONG NOW

FEMA
FLAVOR & EXTRACT MANUFACTURERS ASSOCIATION

THE CULINARY INSTITUTE OF AMERICA

CHICAGOLAND FOOD & BEVERAGE NETWORK

certified WBENC WOMEN'S BUSINESS ENTERPRISE

BEST AND BRIGHTEST COMPANIES TO WORK FOR IN THE NATION

BEST PLACES TO WORK

Best Places to Work in IL
A workplace analysis and competition

rca RESEARCH CHEFS ASSOCIATION

PROUD MEMBER PLANT BASED FOODS ASSOCIATION

IFT
feeding the minds that feed the world

THE WORLD'S **MOST COMPLETE** LINE OF DAIRY FLAVORS

MILK

BUTTER

CHEESE

CREAM

CULTURED

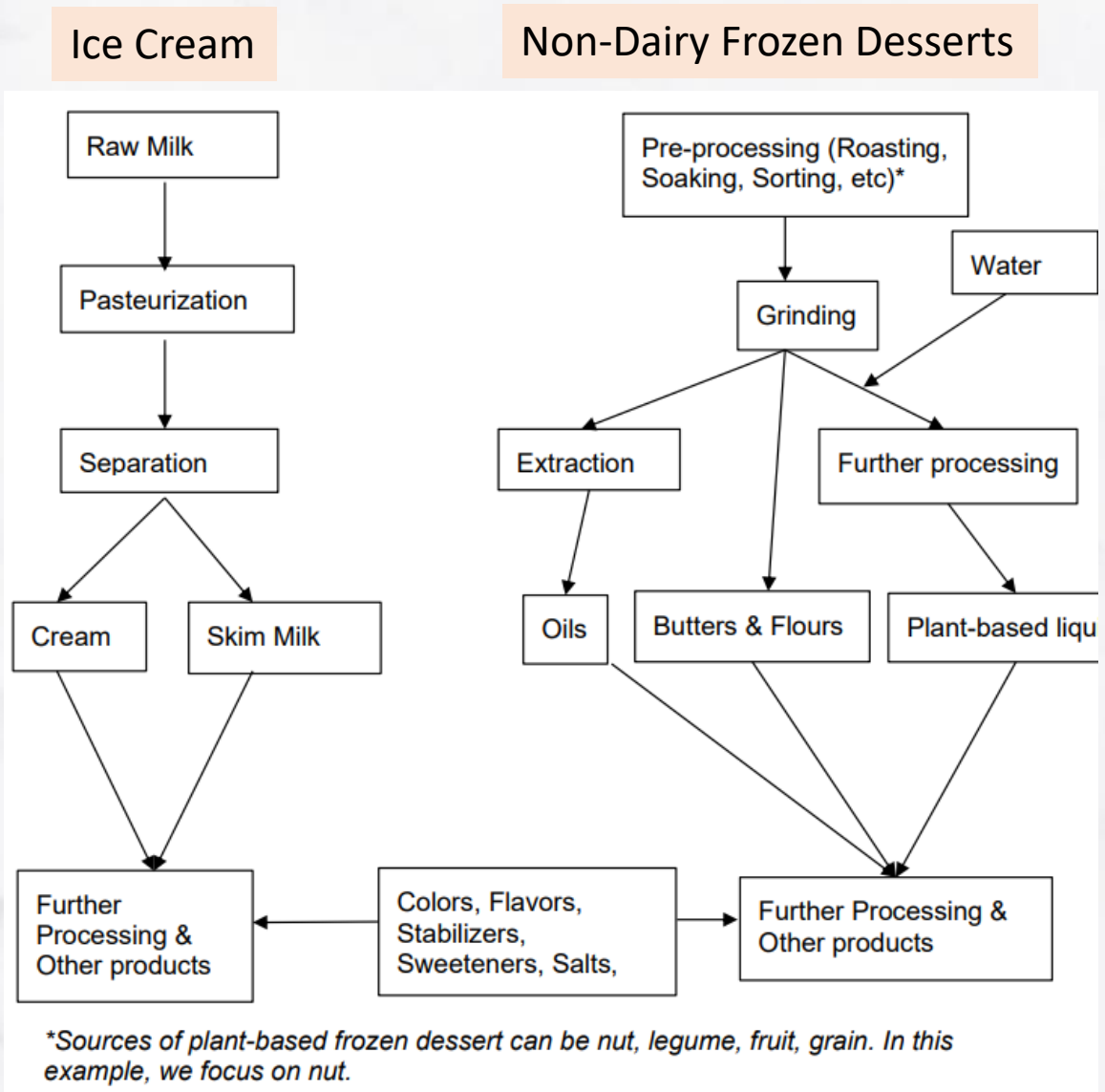
SWEET DAIRY

MASKING / MOUTHFEEL

Where Do Flavor Challenges in Non-Dairy Frozen Desserts Come From?

Non-Dairy Frozen Dessert Manufacture

Source: dairyprocessing.com



(Yip, 2022)

Factors influencing the flavor of non-dairy frozen desserts

Protein Ingredients
Fats and Oils
Ingredient-Ingredient and Ingredient-Flavor Interactions

Thermal Processing
Proper cooling

1. Ingredients

OAT MILK (WATER, OATS), LIQUID SUGAR (SUGAR, WATER), CORN SYRUP, COCONUT OIL, WHEAT FLOUR, WATER, SUGAR, BROWN SUGAR, COCOA (PROCESSED WITH ALKALI), SOYBEAN OIL, CHOCOLATE LIQUOR, PEA PROTEIN, FAVA BEAN PROTEIN, TAPIOCA FLOUR, NATURAL FLAVOR, VANILLA EXTRACT, GUAR GUM, MOLASSES, SALT, LOCUST BEAN GUM, COCOA BUTTER, SUNFLOWER LECITHIN, SOY LECITHIN, INVERT SUGAR.

Impact of Ingredients

Food and Humanity 1 (2023) 1267–1273

Contents lists available at ScienceDirect

Food and Humanity

journal homepage: www.editorialmanager.com/foohum/journal_overview.html

Sensory perception of ice cream and plant-based alternatives evaluated blinded and with ingredient lists

Mackenzie Gorman, Rachael Moss, Matthew B. McSweeney *

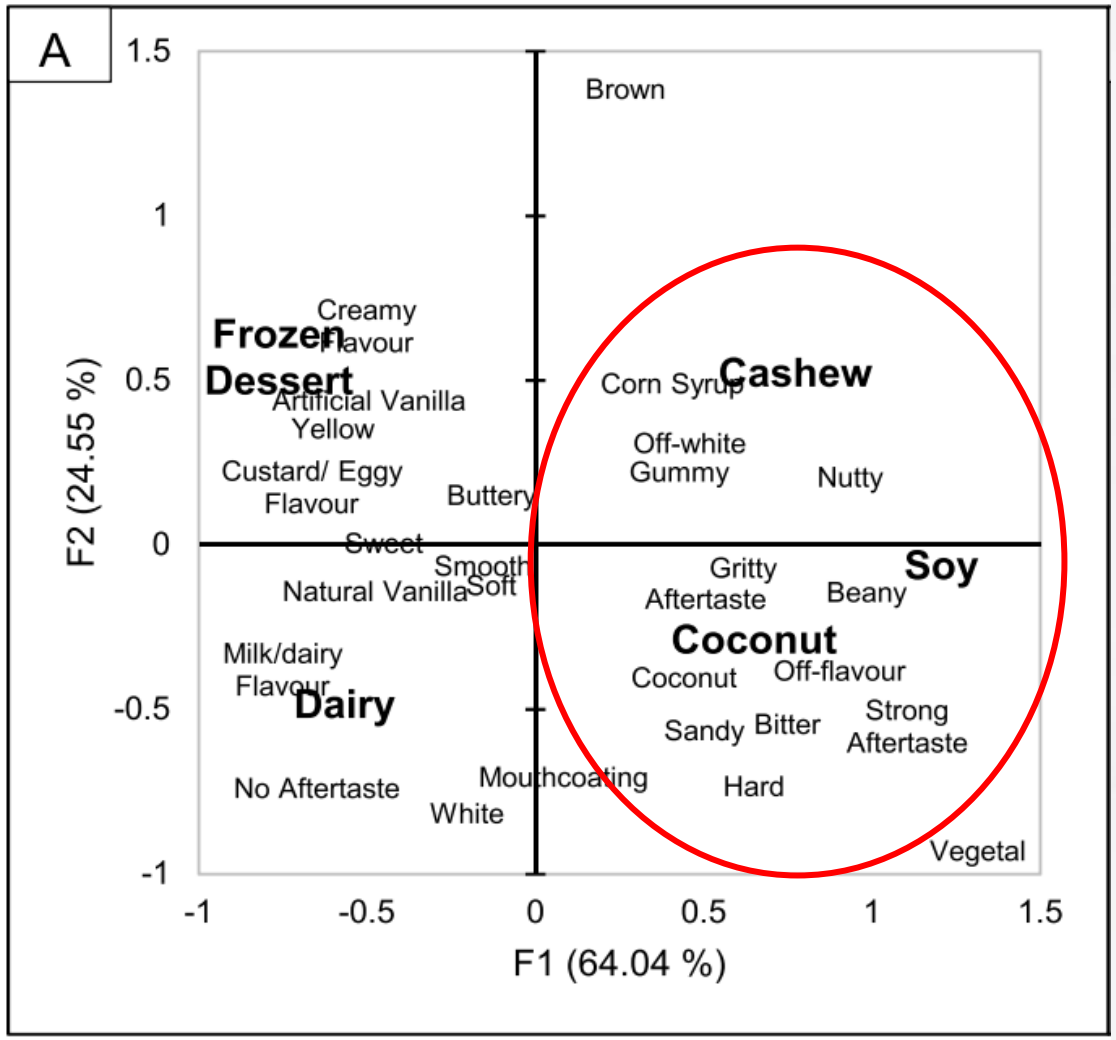
School of Nutrition and Dietetics, Acadia University, Wolfville, NS, Canada

Sample Name	Ingredients
Dairy	Cream, modified milk Ingredients, sugars (sugar, glucose), concentrated skim milk and/or skim milk powder, vanilla bean seeds, vanilla extract, tara gum, mono & diglycerides, natural flavour, carob bean gum, guar gum
Frozen Dairy Dessert (FDD)	Modified milk ingredients, water, sugars (sugar, glucose), coconut Oil, vanilla extract, mono and diglycerides, tara gum, guar gum, natural vanilla flavour, carob bean gum, annato, turmeric extract.
Coconut	Coconut base (filtered water, coconut), sugars (cane sugar, tapioca syrup), coconut oil, pea protein, locust bean gum, guar gum, natural flavour, vanilla bean.
Cashew	Cashew base (filtered Water, Cashews), sugars (cane sugar, tapioca syrup), coconut oil, pea protein, sea salt, locust bean gum, vanilla extract, guar gum, natural flavour.
Soy	Soymilk (filtered water, soybeans), tapioca syrup, cane sugar, soybean oil, inulin, locust bean gum, gellan gum, guar gum, natural flavour.

- ✓ **117 participants evaluated the sensory attributes using CATA technique**

Impact of Ingredients

Sensory Perception Mapping

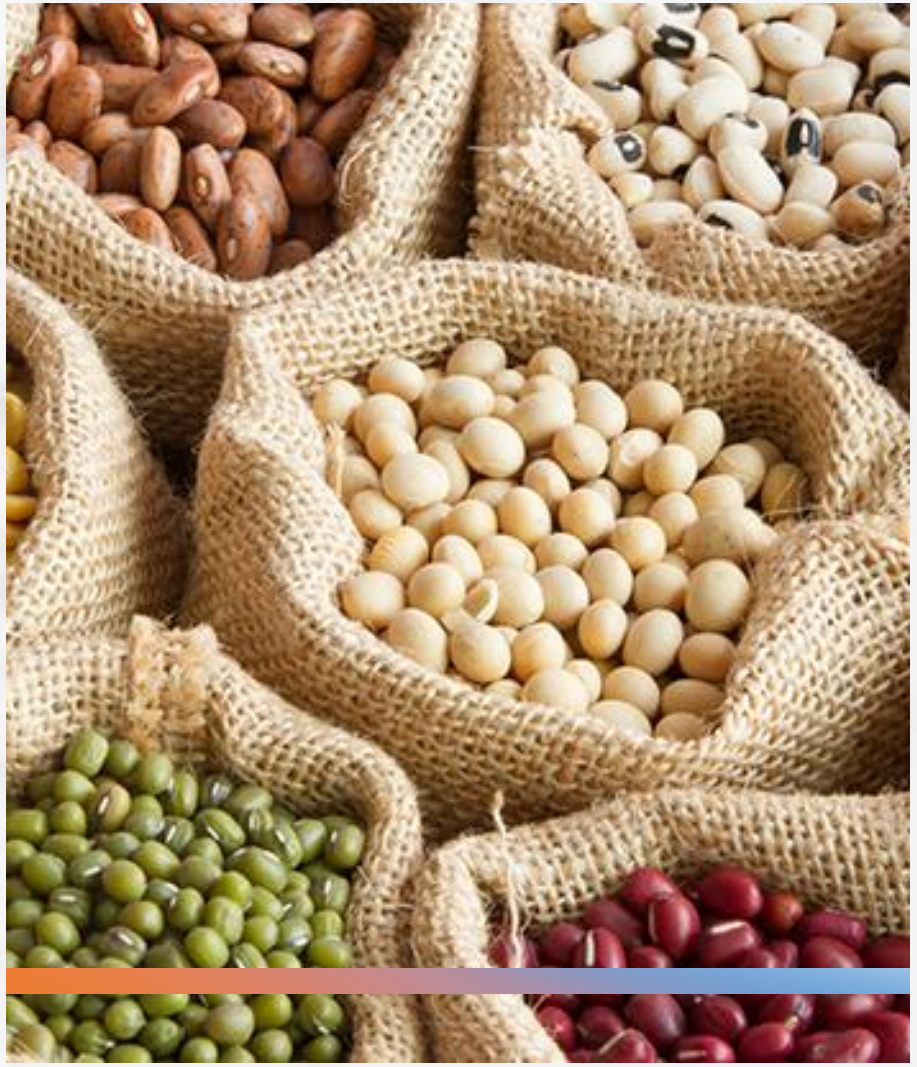


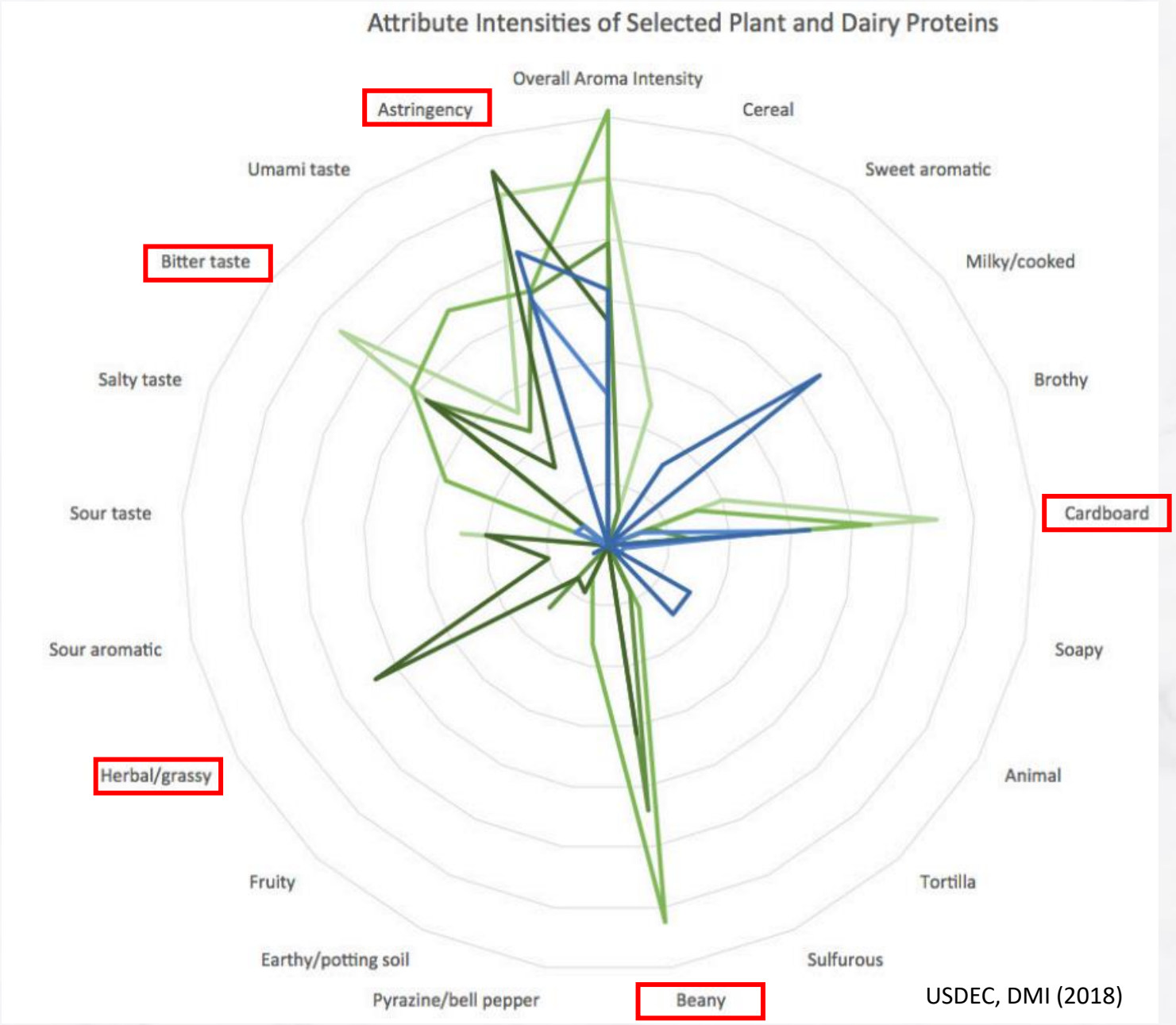
Gorman, M. et al. 2023

Impact of Protein Ingredients

Protein Ingredients

- Inherent (off) flavors
- Protein-Flavor Interactions



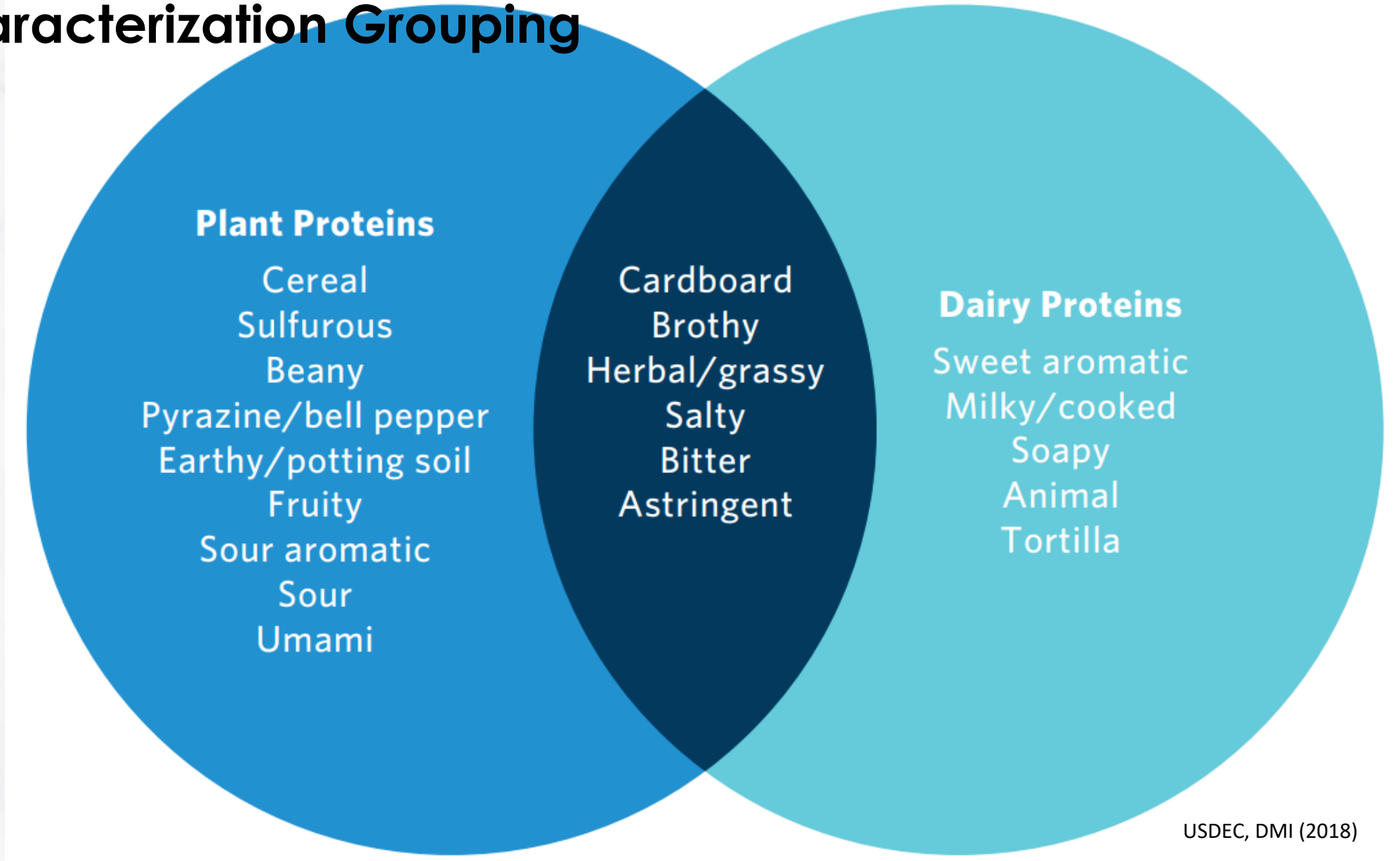


USDEC, DMI (2018)

Plant Protein Characterization

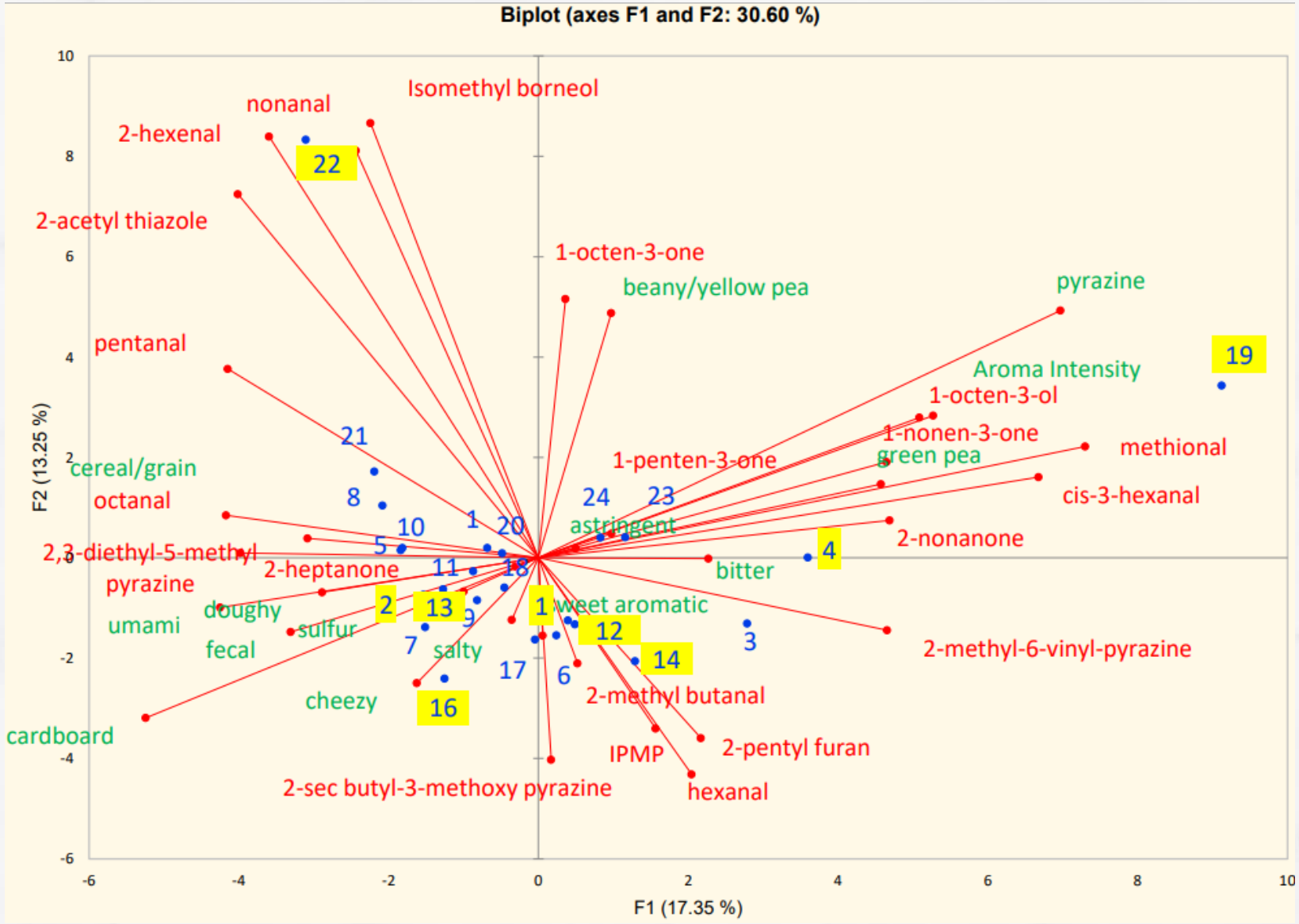
- ✓ 30 different commercial protein ingredients
- ✓ Trained descriptive panel
- ✓ 10% solutions at 21 C

Characterization Grouping



USDEC, DMI (2018)

Flavor Variability in Pea Protein from Various Suppliers



PCA Biplot of sensory properties and volatile compounds of 24 rehydrated commercialized Pea Protein (Liu Y, Cadwallader DC, Drake MA, 2022)

Protein - Flavor Interactions

Table 2. Current understanding of protein-flavour binding mechanisms

Type of interactions	Secondary molecular interactions	Regions or groups of proteins involved	Reversibility	Example of flavours
Physicochemical interactions	Hydrophobic interactions	Interior hydrophobic area of proteins	Reversible	Ketones,[6,26,80] aldehydes,[6] alcohols,[78] ester[62,81]
	Hydrogen bonds	-OH, -COOH, -SH	Reversible	Aliphatic alcohols,[46,78] lactone,[25] volatile acids[25]
	Ionic bonds/electrostatic linkages	$-NH_2$, -OH	Reversible	Volatile acid[25,82]
	van der Waals forces		Reversible	Hydrocarbons[9,46]
Chemical bondings	Covalent linkages	-S-S-, -SH,$-NH_2$	Irreversible	Aldehydes,[79] vanillin,[83] sulphur containing flavours[84]

Kun, D., Arntfield, S. D., 2016. Effect of protein-flavour binding on flavour delivery and protein functional properties: A special emphasis on plant-based proteins

Protein – Flavor Interaction: Hydrophobic Binding

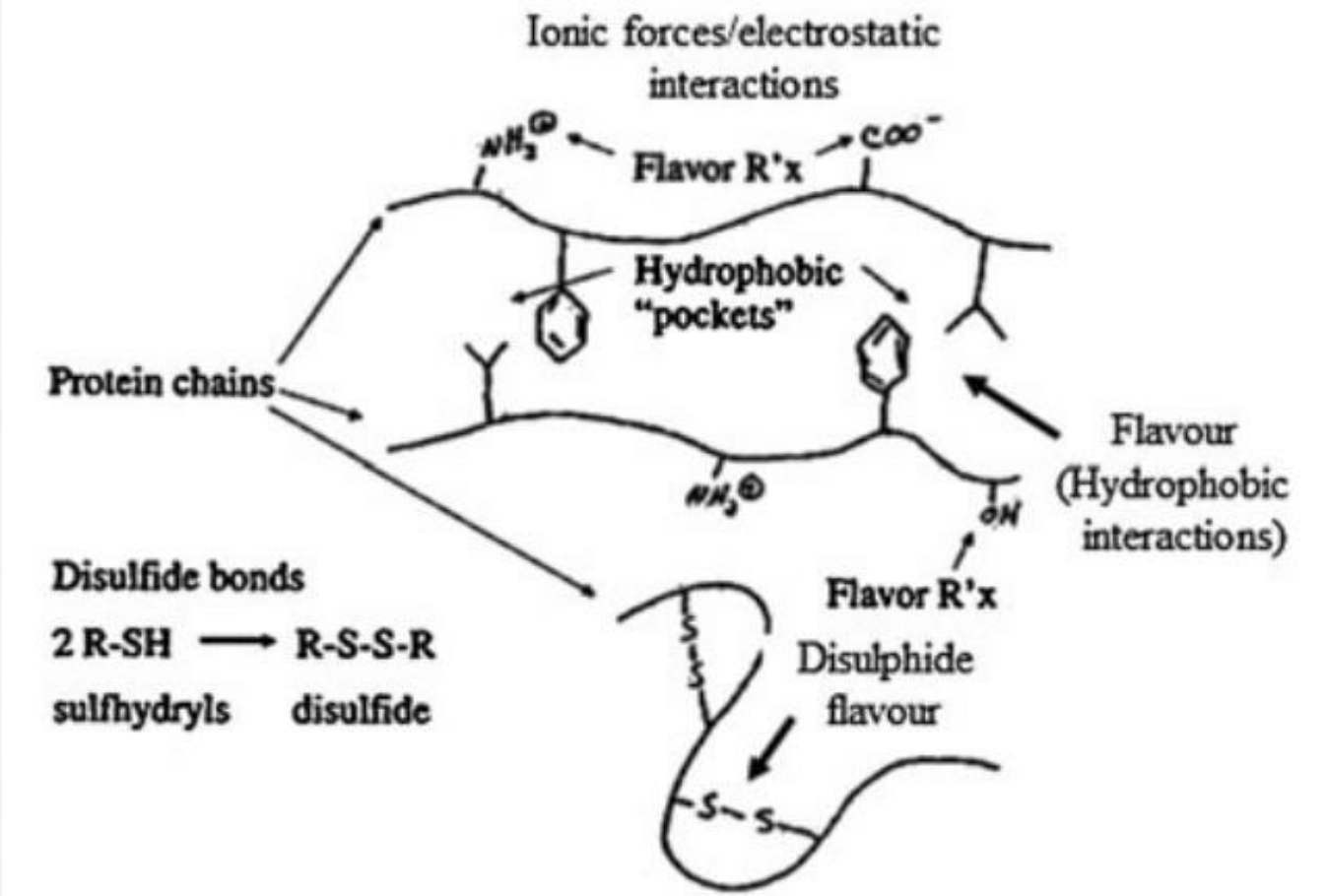


Figure 4. Opportunities for flavour to interact with protein molecules (*Schematic model adapted and modified from Reineccius (2006)*) [4]

- ✓ Flavor muting
- ✓ Loss of flavor over-time

Kun and Arntfield, 2016

Impact of Fats and Oils

- ✓Mouthfeel
  - ✓Due to difference in SFC vs. butterfat
  - ✓Blend fats to get similar SFC (e.g. coconut + soy oil)
- ✓Oxidation
  - ✓Factor in oxidative stability when formulating (e.g. High Oleic oils)

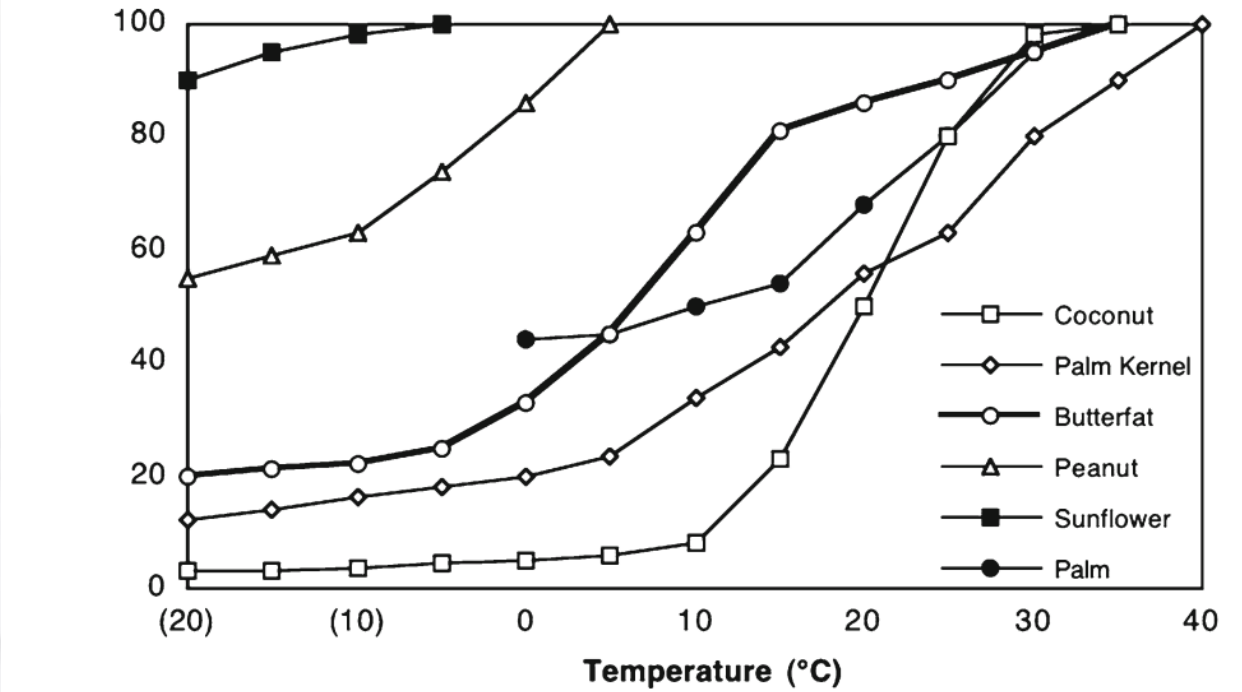
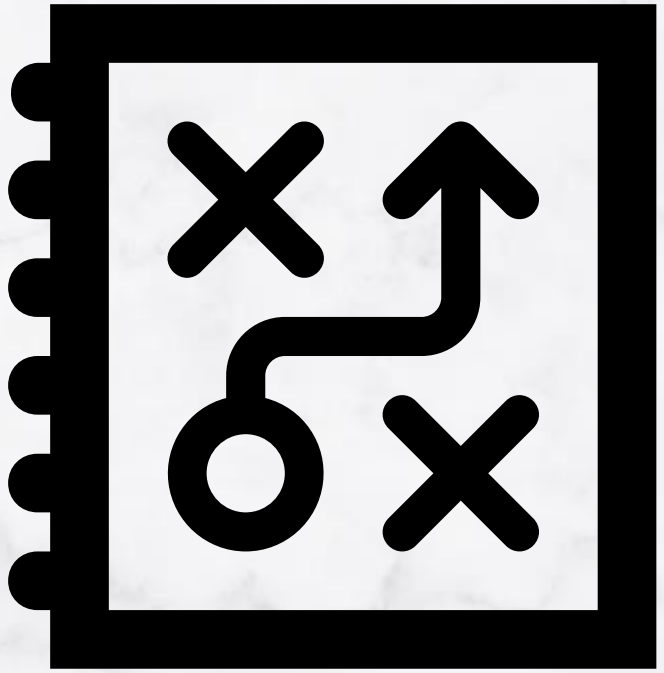


Fig. 3.1 Variation of liquid fat content with temperature for fats suitable for use in ice cream

Goff and Hartel, 2013

Strategies To Mitigate Flavor Challenges In Non-Dairy Frozen Desserts

Strategies To Mitigate Flavor Challenges In Non-Dairy Frozen Desserts



1. Off-flavor **masking**
2. Using **highly aromatic flavors**
3. **Congruent Flavor** Technique
4. **Off-note reduction** (process-driven)
    1. Fermentation (e.g. Fermented pea protein)
    2. Volatilization of off-flavors (e.g. Direct-steam inject)

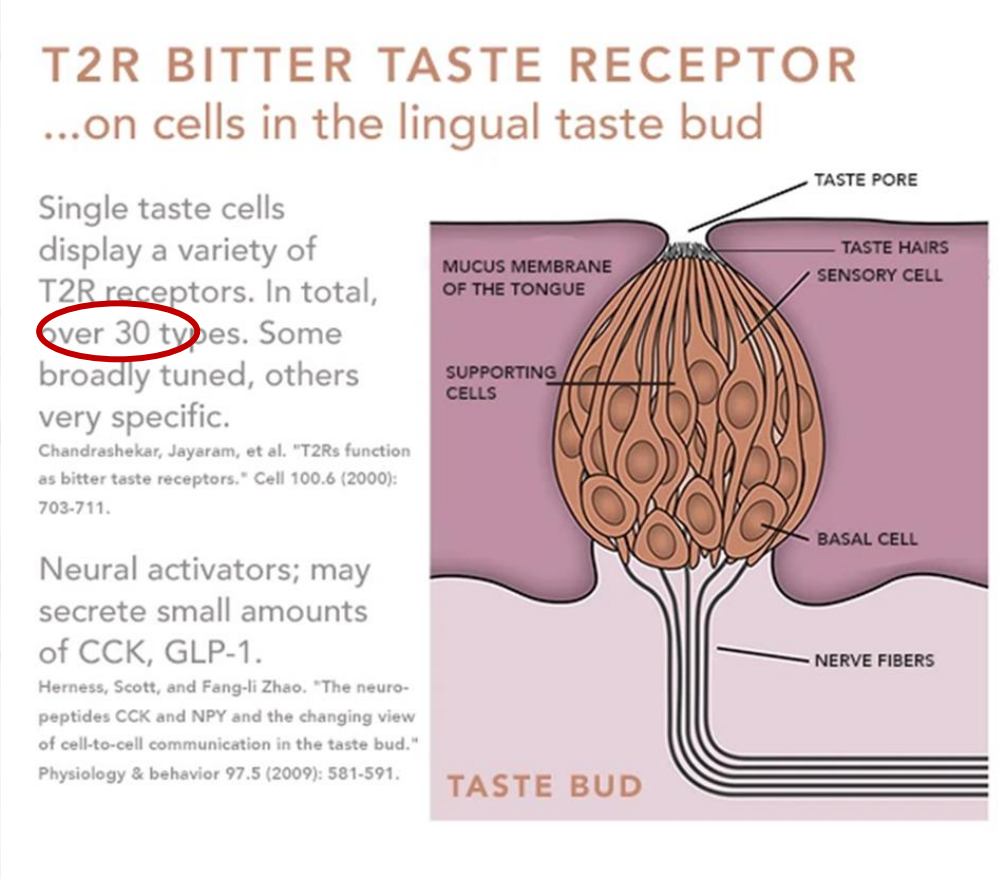
1. Masking

Masking vs. blocking

- Masking: using compounds to neutralize off-notes without imparting characteristic flavor

- Blocking: happens at the taste receptor site, using compounds to bind specific off-note molecule → changing the molecular format→ incompatible to attach at the receptor site.

  More common in pharma/ drug industry.

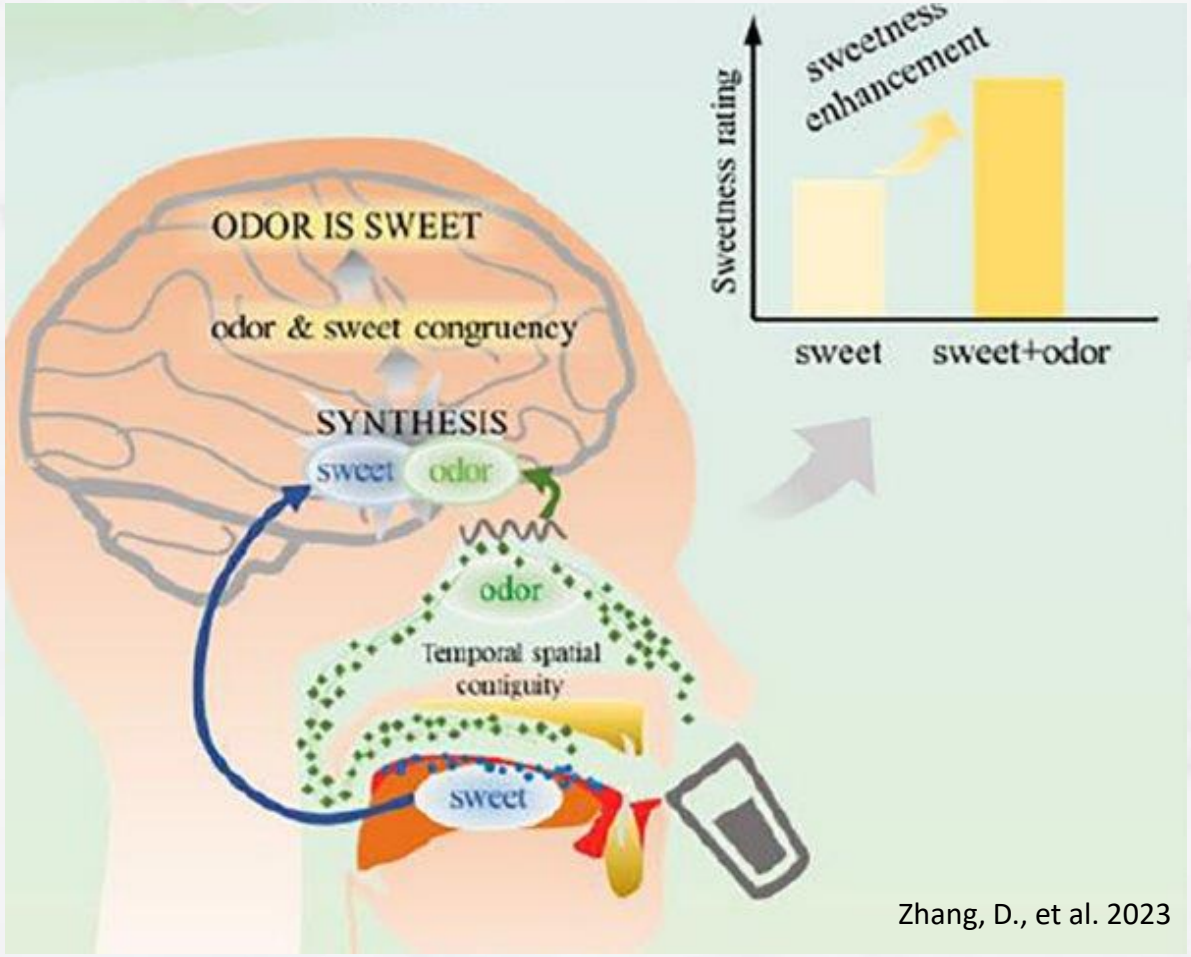


Masking Techniques

- ✓Mixture suppression
  - Using a strong taste to mask other (e.g. sugar, NaCl – beware FPD)
- ✓Using masking flavors
  - Different technologies from different flavor houses

"A spoonful of sugar helps the medicine go down."

2. Using Highly Aromatic Flavors



Zhang, D., et al. 2023

- ✓ High aromatic flavors or extractives to dominate off-notes
- ✓ E.g. blueberry flavor, banana flavor, vanilla, etc.)
- ✓ Odor-induced Taste Enhancement (OITE)

Cross modal sensory interaction of taste and smell

3. Congruent Flavor Technique

- Select flavor profile that work with the note in your base mix.

Mix undertone	Congruent Flavor
Brown caramelic	Caramel, Toffee
Brown, bitter	Chocolate
Cereal	Sugar Cookies

- Some masking work might still be needed to clean up other undesirable off-note (beany, grassy, etc.)

Strategies to mitigate lack of mouthfeel

- ✓Select appropriate Fats and oils, or combination thereof, to create SFC like SFC in milkfat

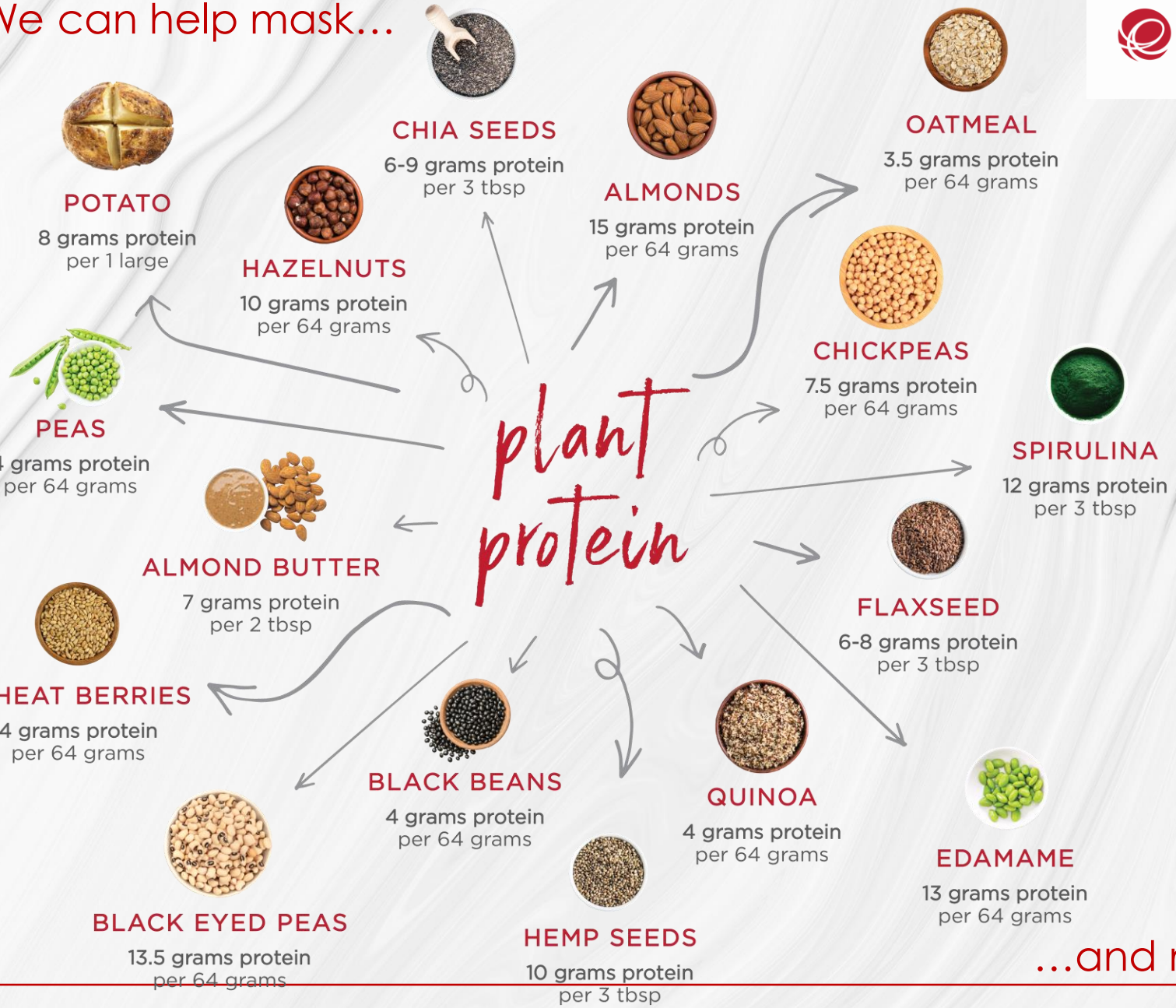
- ✓Using mouthfeel flavors
  - ✓Enhances perception of creaminess and fatty mouthfeel.
  - ✓Proprietary technology

Key Take Aways

- Ingredients are one of the major factors contributing to flavor challenges in non-dairy frozen desserts
  - Alternative proteins and fats
  - Ingredient selection matters
- Major flavor challenges include:
  - Inherent (off) flavors from ingredients
  - Protein-flavor interactions that leads to loss of flavor
- There are various techniques and strategies that are available to reduce off-flavors in non-dairy frozen desserts and other plant based dairy products
- Flavor Masking is the most common technique and can be combined with other strategies to achieve a “winning” product for your consumers.

We can help mask…

EDLONG | *Everything Dairy Can Be.*



Thank You!

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…and more!